

## **EXTREMES OF TEMPERATURE FOR MICROBIAL BIOMARKERS IN ANCIENT PERMAFROST AND ICE**

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In relevance to astrobiology some cosmic models (planet, meteorite, comet, space environment) could be discussed as future objects for search for life. Throughout the evolution they had periods of environmental stability as well as drastic changes. Our planet is one of these systems where life has appeared and developed. Conditions for life on the Earth have varied in wide range on the geological scale, and the diversity of environments increased. Life on the Earth is now ubiquitous, and it is important from viewpoint of astrobiology to combine the knowledge about life in different ecosystems on the cosmic scale. It is necessary to postulate some basic criteria that would describe the model of Earth life in terms of life stability in global planet environment considering the Earth as an object of cosmic evolution. In spite of growing volume of data concerning microbial cell stability under stress factors we have dim understanding what would be the ecosystems response including so called extreme ecosystems to the absolutely catastrophic change of environmental parameters. The history of Mars evolution (as we see it) as well as unclear catastrophic periods in the Earth history require look for final limits of Earth like life in native environment. All extreme environmental investigations follow features of specific adaptations to the major stress factor and revealing of new adopted taxons. In our opinion it is important to emphasize that in relevance to astrobiological goals the presence of widespread organisms in harsh conditions gives new evidences of their great stability to the spectrum of Earth parameters. These “banal” forms represent “face of Earth” and they should be evaluated as “person number one” for astrobiological strategy. Strong adapted extremophiles have limited opportunities for active life, and their stability in resting forms beyond these limits has to be analyzed.

Soil, permafrost and ices in Arctic and Antarctic regions are native environmental models for investigation of low temperature influence on microbial communities on geological time scale. Upper layers undergo rapid environmental fluctuations whereas in deep ancient (frozen) layers physical parameters became almost stable. The data of microbiological investigations allow comparing different models of native cold ecosystems (ice: gas; ice: gas: rock) subject to the level and duration of cold action. One of important conclusions claims the revealing of rapidly resuscitated microorganisms in all ancient permafrost samples and most of ancient ice samples. Mostly non-sporeforming organisms represented this ready to activity part of communities, although in the most low temperature environments the relative abundance of sporogenous bacteria increased. We believe that dormant state is the universal way to cell anabiosis, whereas formation of spores is genetically fixed adaptation of some bacteria for rapid resuscitation from resting state.

In laboratory experiments the influence of temperature beyond Earth limits on microbial communities *in situ* was studied. Indication of fluorescence-positive cells in permafrost after heating up to 180°C and the observation of cell like biomorfs after heating in gradient of more high temperature (several hundreds C degree) allows to make extrapolations to meteorite research: preservation of biomarkers after the exposure at high temperatures provides for their detection in meteorites.